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Mapping Michelangelo's Marble and Its Temporalities

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Abstract

The marble blocks from which Michelangelo Buonarroti sculpted figures for the Tomb of Pope Julius II (1505-1545) originated in the Apuan Alps and traversed coastal routes, rivers, and urban streets before arriving at his workshops. Following completion of the project, some sculptures were repurposed and moved between private collections and public spaces in Italy and France. This study maps the marbles' temporalities from Deep Time to the Anthropocene and illuminates the sculptures' environmental histories. Spatial analysis methods help reveal how the sculptures reflect damage of natural environments they inhabited during these timeframes.

Résumé

Les blocs de marbre à partir desquels Michelangelo Buonarroti sculpta les figures de la tombe du pape Jules II (1505-1545) provenaient des Alpes Apuanes. Ils durent traverser des routes côtières, des rivières et des rues urbaines avant d'arriver dans ses ateliers. Une fois le projet achevé, certaines sculptures furent réaffectées et déplacées entre des collections privées et des espaces publics en Italie et en France. Cette étude cartographie les temporalités des marbres entre le « Deep Time » et l'Anthropocène et éclaire l'histoire environnementale des sculptures. Les méthodes d'analyse spatiale aident à révéler comment les sculptures reflètent les dommages causés à l'environnement naturel dans lesquels elles se trouvaient à ces époques.

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Introduction*

Michelangelo Buonarroti (1475-1564) created several dozen marble artworks, including freestanding figures, relief sculptures, and multi-part monuments, over the course of more than seven decades. Marble blocks quarried for these projects traveled from Carrara and Seravezza to Pisa, Rome, Bologna, and Florence; the sculptures, in various stages of completion, moved from Rome and Florence to Milan, Paris, Bruges, and beyond. Charles de Tolnay included forty-one marble sculptures in his 1975 catalogue;[1] the recent catalogue by Frank Zöllner, Christof Thoens, and Thomas Pöpper attributed forty-three marble sculptures to Michelangelo.[2] Scholars continue to debate certain attributions. Some marble artworks the artist allegedly sculpted have been lost. Michelangelo abandoned other projects for which huge quantities of marble were quarried. Unevenness between archival records, project to project, further complicates quantitative analysis of the marble and its locomotion. Nonetheless, the rich documentation generated by Michelangelo, his associates, and his patrons reveals much about the marbles' itineraries from quarries to workshops to early modern private collections and public spaces. This documentation includes contracts with quarrying firms, payments to stonecutters and carters, and instructions to assistants working at quarries, in workshops, and at installation sites. In these documents, Michelangelo accounted for labor, tools, and shipping; listed measurements and weights of blocks; and scheduled the excavation, preparation, and sculpting of those blocks. This information helps us understand the mobility and stasis of Michelangelo's marble sculptures during the sixteenth century, even if we cannot track individual objects' movements completely. The sculptures themselves, as material archives, contain information about various places where they existed. Provenance data document the artworks' itineraries through the twenty-first century. These textual and material records allow us to map the sculptures' journeys from pre-life to afterlife.

This study examines these journeys, tracing the movement of marble blocks and sculptures through space and time from their origins in the Apuan Alps to their current locations. Scholars have addressed many aspects of the creation and movement of Michelangelo's sculptures, including quarrying practices, physical challenges and material qualities of marble, expenses of transport, frustrations of managing the acquisition of large quantities of stone, and chronologies of commissions. Art historians have situated these events and phenomena within their evaluations of Michelangelo's creative process, style, patronage, biography, and social network.[3] The present study draws upon this foundational research but distinguishes itself by calling attention to temporalities of the marble not frequently acknowledged in art historical scholarship: Deep Time and the Anthropocene.

To describe the vastness of the geological timescale, the writer and journalist John McPhee in 1981 coined the term Deep Time;[4] two centuries earlier, the Scottish naturalist and geologist James Hutton (1726-1797) already had conceptualized this timescale and understood that

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[1] Charles de Tolnay, *Michelangelo: Sculptor, Painter, Architect,* trans. Gaynor Woodhouse (Princeton: Princeton University Press, 1975), 189-219.

[2] Frank Zöllner, Christof Thoens, and Thomas Pöpper, *Michelangelo: Complete Works* (Köln: Taschen, 2016), 366-403.

[3] It is impossible to summarize the scholarship on Michelangelo or to index all work on the tomb project here. For a thorough bibliography, see Zöllner, Thoens, and Pöpper, *Michelangelo*. In addition to scholarship already cited, the following select studies treat the issues listed above and/or bring to light archival documents of particular relevance for the sculptures examined in this article: Erwin Panofsky, "The First Two Projects of Michelangelo's Tomb of Julius II," *The Art Bulletin* 19, no. 4 (1937): 561-579; Charles de Tolnay, *Michelangelo*, Vol. IV, *The Tomb of Julius II* (Princeton: Princeton University Press, 1954); Creighton Gilbert, trans., *Complete Poems and Selected Letters of Michelangelo* (Princeton: Princeton University Press, 1963); Michael Hirst, "A Project of Michelangelo's for the Tomb of Julius II," *Master Drawings* 14, no. 4 (1976): 375-430; Johannes Wilde, *Michelangelo* (Oxford: Clarendon Press, 1979); Claudia Echinger-Maurach, *Studien zu Michelangelos Juliusgrabmal*, 2 vols. (Hildesheim: Olms, 1991); Lucilla Bardeschi Ciulich, "Michelangelo, Marble and Quarry Expert," in *The Genius of the Sculptor in Michelangelo's Work*, ed. Denise L. Bissonette and Maurizia Binda (Montreal: Montreal Museum of Fine Arts, 1992), 169-178; John Pope-Hennessy, *Italian High Renaissance and Baroque Sculpture,* Vol. III (London: Phaidon, 2000), 81-109; Caterina Rapetti, *Michelangelo, Carrara e "i maestri di cavar marmi"* (Florence: All' insegna Del Giglio, 2001); A. Forcellino and M. Forcellino, "Il restauro del tomba di Giulo II a S. Pietro in Vincoli. Una nuova lettura del monumento e del Mosé," *Incontri* 17, no. 1 (2002): 43-59.

[4] John McPhee, *Basin and Range* (New York: Farrar, Straus and Giroux, 1981), 21.

it reached far beyond existing human notions of Earth's age.[5] In this essay, I refer to the names of geological epochs associated with the formation of Apuan marble, but more often I use the term Deep Time in an effort to convey the inapprehensible dimensions of marble sculptures' geological time. The term Anthropocene has been used to describe the current geological epoch since the turn of the twenty-first century.[6] From the Greek word for human (*anthropos*), it denotes that in the current epoch human activity has shaped (and continues to shape) the geological record.[7] Throughout this essay, I deploy the term Anthropocene to identify one of the temporalities within which the marble sculptures exist. I use related words (anthropogenic, anthropocenic) to characterize human beings' transformation of the geological record associated with the sculptures under consideration and to characterize the sculptures themselves.[8]

Putting these three temporalities into conversation – the geological age of the stones (Deep Time), the existence of the marble blocks and sculptures in the early modern period, and their persistence in the present (Anthropocene) – generates insights to the long environmental history of the artworks and to the ecological entanglements present within them.[9] When we confront the sculptures in their current museum locations or as digital or print reproductions, we experience them out of context from the quarries, workshops, and other early modern places where they existed, moved, and became entangled. In addition to the various kinds of archival data already listed, site visits and satellite imagery generate data that help us understand the current condition of quarries and urban and rural spaces where the blocks and sculptures existed. Geological maps visualize the Deep Time of the material and the spatial expanses of it. Together, these data tell the story of how the marble blocks moved, how the sculptures took shape in the early modern period, and how the natural environment affected and has been affected by these translocations and transformations. This study examines these multiple kinds of data using quantitative analysis and digital mapping methods to clarify the role of the artworks in an ongoing environmental history narrative.[10]

This essay follows the journeys of marble blocks quarried and sculptures carved for the Tomb of Pope Julius II (1505-1545) through these three temporal frames and around mountainous, watery, and urban environments. The marble sculptures are peregrinating polychronic actors.[11] The sculptures inhabit and represent multiple temporalities simultaneously, and evidence of their polychronicity appears on their surfaces, which bear traces of both human and nonhuman forces associated with different timeframes and geographical places. By connecting temporal durations with places, the map brings into focus how the sculptures respond to, record, and affect environmental conditions at those places. The processes of data curation, digital geographical

[5] On Hutton see, for example, Barry Wood, "Petrotemporality at Siccar Point: James Hutton's Deep Time Narrative," in *Time's Urgency,* ed. Carlos Montemayor and Robert Daniel (Leiden: Brill, 2019), 157-178.

[6] The ecologist Eugene F. Stoermer is credited with first using the term "anthropocene" in the 1980s; Stoermer and the atmospheric chemist Paul Crutzen co-authored a short paper that is one of the first arguments for the use of this term to name the current geological epoch. See P.J. Crutzen and E.F. Stoermer, "The Anthropocene," *IGBP Global Change Newsletter* 41 (2000): 17-18.

[7] The current definition of Anthropocene, recent votes of the Anthropocene Working Group of the Subcommission on Quaternary Stratigraphy of the International Commission on Stratigraphy, and bibliography on the Anthropocene can be found here: http://quaternary.stratigraphy.org/working-groups/anthropocene/

[8] The scientific community debates whether to officially name this epoch the Anthropocene and when to place its beginning. Some scientists argue that the Anthropocene's beginning should be located around the time of the Industrial Revolution, while others argue for the mid-twentieth century. Recently, an early modern beginning date of 1610 also has been proposed. See Simon L. Lewis and Mark A. Maslin, "Defining the Anthropocene," *Nature* 519 (March 2015): 171-180.

[9] Essential for thinking about these kinds of ecological entanglements: Jane Bennett, *Vibrant Matter: a political ecology of things* (Durham and London: Duke University Press, 2010); Timothy Morton, *The Ecological Thought* (Cambridge, MA: Harvard University Press, 2010); Jeffrey Jerome Cohen, *Stone: An Ecology of the Inhuman* (Minneapolis: University of Minnesota Press, 2015); and Serenella Iovino, *Ecocriticism and Italy: Ecology, Resistance, and Liberation* (London: Bloomsbury, 2016). Environmental history projects engaged in the geologic turn also inform the treatment of human and non-human actors in this article: see for example, Arash Khazeni, *Sky Blue Stone: The Turquoise Trade in World History* (Berkeley: University of California Press, 2014) and Hugo Reinert, "About a Stone: Some Notes on Geologic Conviviality," *Environmental Humanities* 8, no.1 (May 2016): 95-117.

[10] Carrie Anderson makes a related argument about the process of digitally mapping archival data onto early modern maps to create a new, de-centered representation of indigenous-Dutch relationships in colonial Brazil. See: Carrie Anderson, "Mapping Colonial Interdependencies in Dutch Brazil: European Linen & Brasilianen Identity," *Artl@s Bulletin* 7, no. 2 (2018): Article 7.

[11] My formulation draws upon ecomaterialism (and by virtue of this, upon Actor-Network-Theory, or ANT), and art historical scholarship on artworks' relationships to time. On ANT and ecomaterialism see Bruno Latour, *Reassembling the Social – An Introduction to Actor Network Theory* (Oxford: Oxford University Press, 2005); Bennett, *Vibrant Matter*; and Iovino, *Ecocriticism and Italy*. For the application of ANT to art history see Michael Zell, "Rembrandt's Gifts: A Case Study of Actor-Network-Theory," *Journal of Historians of Netherlandish Art* 3, no. 2 (Summer 2011), 1-25. On ways artworks travel through time or manifest duration across time, see for example Aby Warburg, *The Renewal of Pagan Antiquity: Contributions to the Cultural History of the European Renaissance*, trans. David Britt (Los Angeles: Getty Research Institute, 1999); George Kubler, *The Shape of Time: Remarks on the History of Things* (New Haven and London: Yale University Press, 1962); Rosalind E. Krauss, *Passages in Modern Sculpture* (Cambridge, MA, and London: MIT Press, 1981); Alexander Nagel and Christopher S. Wood, *Anachronic Renaissance* (New York: Zone Books, 2010).

visualization, and users' manipulation of the digital map together reinstantiate materials' presence at these places. The coupling of these digital research methods with ecomaterial analysis illuminates Michelangelo's marble sculptures as temporal mediators that offer beholders both a retrospective lens with which to examine environmental change and the prospect of better understanding human relationships to geological time and matter.

Temporalities of Michelangelo's Marble

Marble measured time in Michelangelo's life. As his biographer Giorgio Vasari (1511-1574) proclaimed, "Michelangelo consumed many years in quarrying marbles..."[12] Vasari made this statement describing Michelangelo's preparations for the never-realized San Lorenzo façade project, for which Michelangelo made nineteen visits to Carrara and Seravezza quarries between 1516 and 1520.[13] Michelangelo stayed eight months in the Carrara mountains in 1505 procuring marble for the Tomb of Pope Julius II,[14] and in 1516, he returned to Carrara for the same purpose.[15] In total, Michelangelo visited quarries more than two dozen times between 1498 and 1525.[16] Michelangelo's correspondence, contracts, and other records shed light upon the time he spent in quarries and managing work therein. These documents attest to not only the length of some visits, like those Vasari references, but also month-to-month and day-to-day activities in quarries. For instance, writing from Carrara in September 1516, Michelangelo summarized his progress there: "I've begun quarrying marble in many places and I hope, if it remains fine, to have all my marbles [for the Tomb of Julius II] ready within two months."[17] A few months later, in March 1517, Michelangelo wrote about contracts he canceled and others he initiated with Carrara marble firms to provide and ship by barge within a year 200 *carrate* of marble for the San Lorenzo project.[18] As the Michelangelo scholar William Wallace observed,

> For nearly every major project requiring fine statuary marble, Michelangelo began with a trip to the quarries: in 1498 for the Rome *Pietà,* in 1501 for the Piccolomini altar, in 1503 for the twelve apostles, in 1505 and 1516 for the tomb of Julius II, in 1518 for the San Lorenzo façade, and finally in 1521 for the Medici Chapel.[19]

These quarry visits demarcated chapters of Michelangelo's life; records of this lithic time-marking, such as those quoted above, describe material, geographical, and temporal significances of the marble.

Between trips, Michelangelo and his quarry associates corresponded regularly to cement agreements about the particular veins from which blocks would be quarried, the dimensions and quality of the quarried blocks, and the methods of transport that would be used to move them. For example, Michelangelo repeatedly insisted that quarry workers cut pure white blocks for his projects: in 1518, according to contractual documents, Michelangelo ordered marble blocks "free of veins and imperfections," and in 1521 he demanded material that was "white, without veins or other markings."[20] In the same 1521 document, the volume, price, location, and timeline for production of the marble also are addressed – 200 *carrate* from the Polvaccio quarry area, with measurements to be provided by Michelangelo and work to proceed for at least eighteen

[12] Giorgio Vasari, *Lives of the Painters, Sculptors and Architects*, Vol. II, trans. Gaston du C. de Vere (New York and Toronto: Alfred A. Knopf, 1996), 678.
[13] For a summary of Michelangelo's travel during this period, see William Wallace, *Michelangelo at San Lorenzo: The Genius as Entrepreneur* (Cambridge and New York: Cambridge University Press, 1994), 26.
[14] Vasari, 659.
[15] *Il carteggio di Michelangelo*, Vol. I, ed. P. Barocchi and R. Ristori (Florence: S.P.E.S., 1965), 201.
[16] Michelangelo's practice of visiting quarries was not singular among early modern sculptors and architects; from at least the thirteenth century, artists visited Tuscan quarries. For a summary of these visits by Michelangelo and others and of the scholarship tracing them, see Wallace, *Michelangelo at San Lorenzo,* 25-26. Also see Christiane Klapisch-Zuber, *Les maitres du marbre: Carrare 1300-1600* (Paris: S.E.V.P.E.N., 1969).
[17] *The Letters of Michelangelo, Volume One, 1496-1534*, trans. E.H. Ramsden (Stanford: Stanford University Press, 1963), 103. Michelangelo, *Carteggio*, I, 1965, 201.
[18] Michelangelo, *Carteggio*, I, 1965, 267. One *carrata* (cart load) is equivalent to about 850 kg. See Wallace, *Michelangelo at San Lorenzo*, 8.
[19] Wallace, *Michelangelo at San Lorenzo,* 70.
[20] Contracts XLI (1 June 1518) and XLVIII (22 April 1521). See *Le lettere di Michelangelo Buonarroti*, ed. Gaetano Milanesi (Florence: Le Monnier, 1875), 685, 694. "Li quali marmi s' àranno ad cavare in Finochiaia della Cappella, iurisdictione e vicinanza di Pietrasanta, de' più belli che sono in detto loco, netti di vene e di peli, per pregii che fe' maestro Allixandro di Giovanni di Bertino da Septignao, ogni excusatione e cavillatione remossa." And: "…siano di marmot vivo et non cotto, bianco et senza vene, machie et peli alcuni."

months.[21] Other primary sources, such as Vasari's biography of Michelangelo, describe the movement of blocks between workshops and storage areas and a variety of installation sites; these descriptions enable us to trace shipments of marble from Carrara and Seravezza to Florence and Rome, along their streets, and beyond. Thus, these archival and primary sources provide insights about the temporalities and spatiality of Michelangelo's marble sculptures during the sixteenth century. Moreover, within the documents describing surface qualities of stones (their veins and imperfections) and processes of excavation, sixteenth-century people acknowledged facets of the material that reflect its travel through Deep Time. Mapping the temporal and spatial data drawn from these sources reinforces some existing ideas about the lives of the artworks; layering these early modern data upon Deep Time data facilitates analysis of the relationships between the archival record, the geological record, artworks, and humans who altered natural environments, created and moved sculptures, beheld artworks, and generated (or failed to generate) documentation about these activities.

Mapping Time in Digital Space

Spatial humanities methods, such as the GIS analysis and digital geographical visualizations used in this study, may help to illuminate trends and phenomena within artworks' histories that conventional approaches struggle to identify and illustrate. But as many spatial humanists have noted, existing technologies do not provide much flexibility for the examination and representation of time. Web-mapping and GIS platforms tend to treat time as a fixed[22] and "categorical and discontinuous" element.[23] Moreover, socially constructed time cannot be traced effectively by existing mapping tools,[24] and fuzzy data, perennially challenging for digital humanities projects, are difficult to reconcile with the metadata standards of digital tools. Early modern sources, like those informing this project, often produce datasets riddled with unevenness, imprecision, and uncertainty.[25] Early modern notions of time and practices of timekeeping do not accord with standard digital measures of time.[26] These multiple temporal issues make mapping early modern time accurately and with nuance almost impossible within the confines of existing, off-the-shelf platforms.[27]

All of these challenges affect the analysis and visualization of temporal data in the present study, which uses Google Earth Pro and the free version of the platform CARTO to create a multi-layered, interactive digital map of the marble blocks' and sculptures' itineraries.[28] These itineraries are comprised of segments defined by timescales of vastly different proportions. The blocks and sculptures existed at a variety of locations for periods ranging from a few months to a few hundred years to more than twenty million years. Attempting to represent the multiple timescales of the sculptures' spatial histories, the map includes four layers that emphasize time: "Movement" (an

[21] For the drawings and measurements of stones on order for the San Lorenzo project, see William Wallace, "Drawings from the "Fabbrica" of San Lorenzo during the Tenure of Michelangelo," *Studies in the History of Art* 33, Symposium Papers XVII: Michelangelo Drawings (1992): 116-141.
[22] Edward L. Ayers, "Mapping time," in *GeoHumanities: Art, history, text at the edge of place*, ed. Michael Dear, Jim Ketchum, Sarah Luria, and Douglas Richardson (New York: Routledge, 2011), 215.
[23] David J. Bodenhamer, "Chasing Bakhtin's Ghost: From Historical GIS to deep mapping," in *The Routledge Companion to Spatial History*, ed. Ian Gregory, Don DeBats and Don Lafreniere (New York: Routledge, 2018), 536.
[24] David J. Bodenhamer, "Narrating Space and Place," in *Deep Maps and Spatial Narratives*, ed. David J. Bodenhamer, John Corrigan, and Trevor Harris, (Bloomington: Indiana University Press, 2015), 10.
[25] For further discussion of uncertainty, precision, and remediation of early modern spatial data, see Catherine Walsh, "Unsettled Sculptures: Mapping the Afterlife of Ammannati's *Juno Fountain*," *Journal18* Issue 5 *Coordinates* (Spring 2018), http://www.journal18.org/2678. DOI: 10.30610/5.2018.2
[26] And until 1582, the Julian calendar was standard in early modern Europe; once the Gregorian calendar was introduced, all areas did not adopt it simultaneously. On the developments in timekeeping in the early modern period see for example, Rachel Doggett and Susan Jaskot, *Time: The Greatest Innovator; Timekeeping and Time Consciousness in Early Modern Europe* (Washington, D.C.: The Folger Shakespeare Library, 1986).
[27] Several notable digital humanities projects have confronted these challenges in order to prioritize temporal data as much as they do spatial data. Most of the following examples benefitted from purpose-built digital environments to negotiate the kinds of temporal issues described above and to liberate temporal data from its typical, fixed status within mapping platforms: *HyperCities*, *Virtual Morgantown*, *Mapping Titian*, several *Visualizing Venice* projects, *Aquae Urbis Romae: the Waters of the City of Rome*, and geographer Charles Travis's model of a digital chronotopic cube, presented in his essay examining Flann O'Brien's novel *At Swim Two Birds* (1939), which maps time onto spaces of the text and visualizes both temporal and locational data within the framework of a GIS platform. See Charles Travis, "Transcending the cube: translating GIScience time and space perspectives in a humanities GIS," *International Journal of Geographical Information Science* 28, no. 5 (2014): 1149-1164.
[28] The dataset is available here: https://docs.google.com/spreadsheets/d/19Vx1YLoGg2yoiSdHY_1M_n4LqqOgumAUUC44b4akjRA/edit?usp=sharing

animation of the movement of individual sculptures through time); "Location Types and Dates"; "Number of Years at Locations"; and "Persistence and Uncertainty" (with markers scaled for length of time and color-coded to indicate the relative certainty of the temporal data).[29] Two other layers emphasize space: "Torano Basin" and "Transportation Routes." While representing time, these geographically-anchored visualizations still subordinate and simplify the temporalities of the stones' lives relative to spatiality. Moreover, the dynamic digital map cannot be illustrated fully or addressed completely within the confines of a conventional journal article. To better appreciate the successes and the challenges of the map, readers are encouraged to access it at the web address in the footnote below. Using the layers, filters, and search function will provide readers better understanding of the static map illustrations embedded in this essay and a richer experience of the following discussion.

Despite the challenges outlined above, the processes of curating and mapping the dataset for the Tomb of Julius II generate questions about the temporal-spatial journeys of marble that are absent from conventional approaches to this monument. The map associates locations with the amount of time that the blocks and sculptures endured at these locations. By correlating the state of the stone with locations – roughly hewn, "raw" material (in quarries and storage areas) as compared with work-in-progress (for example, the *Slaves* that lived in the Florence workshop for several decades) as compared with completed artworks (the final version of the tomb at San Pietro in Vincoli) – and locations with temporal frames, the map provokes further consideration of the environment's influence on the status of the stone and the production and preservation of information about it. Tracing blocks' and sculptures' itineraries from Deep Time to the Anthropocene, the map links these temporal frames through the marble. As the map allows users to follow the blocks' and sculptures' long temporal journeys, it opens up lines of inquiry about the impact of geological processes, topography, weather, and anthropogenic change to the natural environment on the mobility and stasis of the marble blocks and sculptures.

The Tomb of Julius II Traveling through Time and Space

In early 1505, Pope Julius II (1443-1513; r. 1503-1513) commissioned Michelangelo to create a colossal funerary monument that initially the patron and artist intended to erect inside St. Peter's Basilica. Michelangelo began work on the project in 1505, but he did not finish it until 1545, when the installation of the monument in San Pietro in Vincoli in Rome was completed. Michelangelo's ability to pursue this project and honor his contracts, first with Julius II and later with the pope's heirs, repeatedly was stymied. The vicissitudes of the project, including the interference of other patrons, Michelangelo's multiple revisions to the design, the shifting installation location, and his negotiations with the della Rovere family have been discussed in great nuance elsewhere, just as the style of the figures has been a regular topic of Michelangelo scholarship.[30] Important though they are for comprehensive understanding of the tomb, these issues are set aside here. Instead, I evaluate the temporal-spatial journeys of the sculptures attributed to Michelangelo: *Moses, Leah,* and *Rachel* (San Pietro in Vincoli, Rome); *Dying Slave* (Fig. 1) and *Rebellious Slave* (Musée du Louvre, Paris); *Atlas Slave* (Fig. 2), *Bearded Slave, Young Slave,* and *Awakening Slave* (Galleria dell'Accademia, Florence); and the *Victory* (Palazzo Vecchio, Florence).[31]

[29] The map is accessible here: https://catwalsh.carto.com/builder/d55673f6-a541-482d-a4b1-a66506eca874/embed
Click on the arrow on the left side of the CARTO screen to reveal information about the map and tips for navigating it.

[30] See note 3, above.

[31] In addition to these ten sculptures, de Tolnay identified another "unfinished" tomb sculpture in the Casa Buonarroti, and Wilde discussed another sculpture like the *Slaves* that was sold and repurposed into smaller blocks. See Charles de Tolnay, "Contributi Michelangioleschi. XVI. Un prigione sconosciuto per la tomba Giulio II di Michelangelo," *Commentari* (1965), 85-96; Johannes Wilde, *Michelangelo, the Group of Victory* (London: Oxford University Press, 1954), 12; and, Edith Balas,

Figure 1. Michelangelo Buonarroti, *Dying Slave*, c. 1513-1516, marble, 215 cm high (Musée du Louvre, Paris). Photo credit: Scala / Art Resource, NY.

With the exceptions of the first three in this list, the sculptures were not incorporated into the final version of the monument and instead were repurposed. Reuse meant moving the sculptures multiple times. The two Louvre sculptures migrated from Rome to France in the mid-sixteenth century and arrived at the Louvre in the late eighteenth century.[32] The five other sculptures moved to sites in Florence after Michelangelo's death and in the early twentieth century. These ten sculptures, especially the seven repurposed figures, allow us to examine the presence and absence, peregrinations and persistence of marble blocks and artworks in a variety of environments through time. As material, most of the marble blocks (eight out of ten) seem to have moved longer distances than they did as sculptures.[33] As sculptures, the marble moved more often, from workshops to installation sites, between private collections, and to public spaces. Certainly the workshop locations where they were housed (Rome versus Florence), Michelangelo's own move from Florence to Rome, and their political value as cultural capital affected when some of the sculptures moved and where they traveled. But also their movement to certain places – especially the six *Slaves'* movements to courtly residences and garden spaces – related to the sculptural forms' flexibility, which partly derived from their polychronic nature, which, in turn, connects to their environmental history. The remainder of the essay examines these connections between location, material, time, environmental conditions, and artworks.

Figure 2. Michelangelo Buonarroti, *Atlas Slave*, before 1534, marble, 282 cm high (Galleria dell'Accademia, Florence). Photo credit: Scala / Art Resource, NY.

"Michelangelo's Florentine Slaves and the S. Lorenzo Façade," *Art Bulletin* 65, No. 4 (1983): 668.

[32] On the personal and political reasons for Michelangelo giving these sculptures to Roberto Strozzi between 1544 and 1550, and Strozzi subsequently giving them to the King of France, see Maria Ruvoldt, "Michelangelo's *Slaves* and the Gift of Liberty," *Renaissance Quarterly* 65, no. 4 (2012): 1029-1059.

[33] However, because of the potential to interchange blocks, swapping from one project to another, this is difficult to claim with complete certainty. See note 54, below.

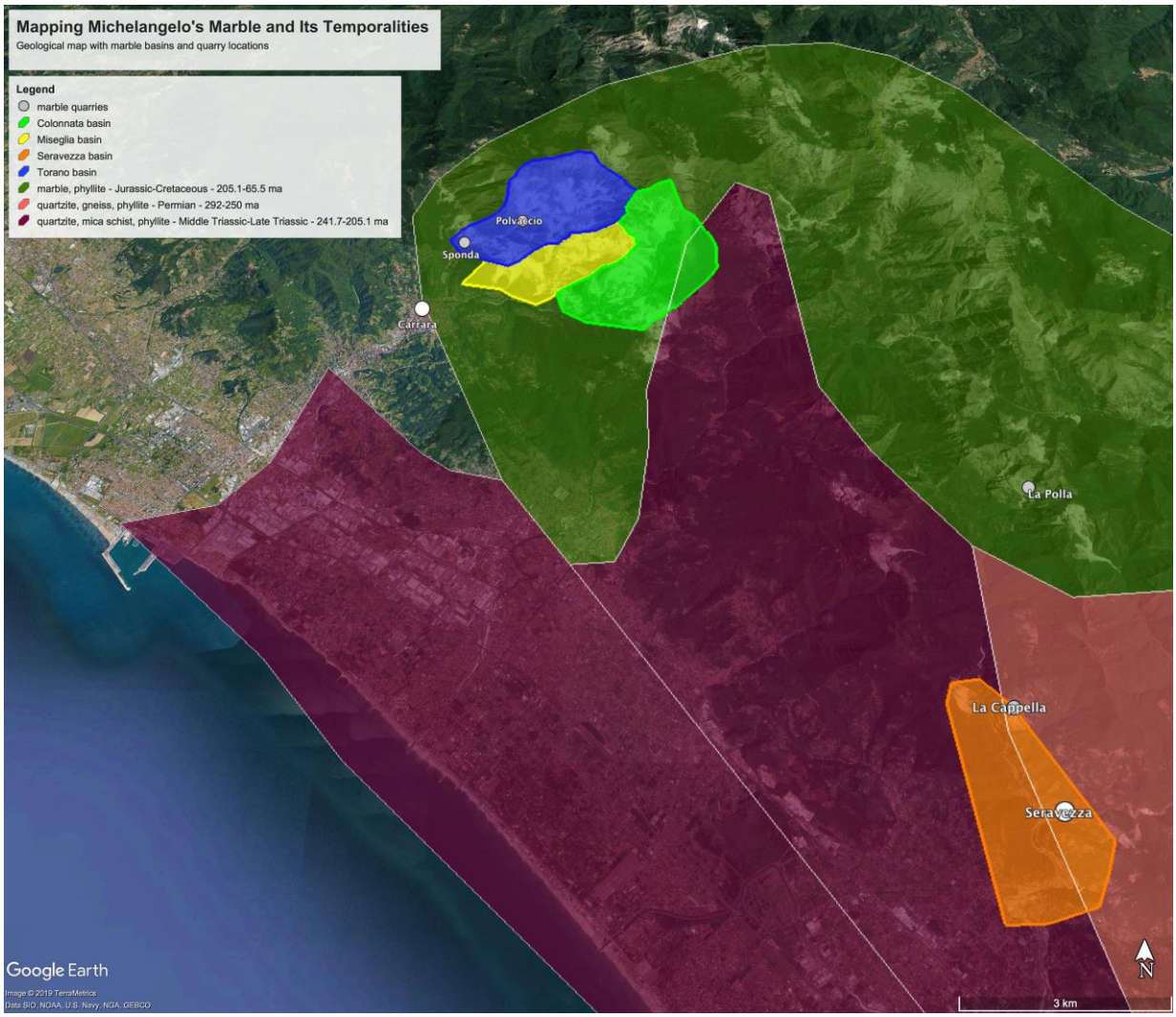
The sculptures' journeys begin in Deep Time in the Massa-Carrara marble fields, located in the Apuan Alps, part of the Apennine Mountains in northern Tuscany. Hugging the Ligurian Sea, the Apuan range stretches about 50 kilometers in length and about 20 kilometers in breadth. The highest peak reaches 1,947 meters. The topography took shape during the Early Pleistocene, as early as 2.5 million years ago. The marble deposits near Carrara and Seravezza come from limestone formed during the Late Triassic-Early Jurassic, about 200 million years ago; the metamorphosis from limestone to marble began in the Late Oligocene, about 28 million years ago.[34] The marble-producing metamorphosis suppressed visual evidence of prior organic and geological processes – decomposition of calcium-rich matter, like shell and coral, and its compression into limestone. Through the heat and pressure exerted in these processes, the limestone recrystallized and the fossil record was obscured. At some locations near Carrara and Seravezza, these metamorphic processes produced stone that appears to be nearly pure calcite, largely free from silt, clay, or other substances or minerals causing veining and coloration.[35] This marble partially covers up its own record of generation at the same time that its materiality reflects earth (and remnants of earth's creatures) moving through Deep Time.

Michelangelo identified marble veins producing stone with these qualities at the quarry sites of Polvaccio and Sponda near Carrara, and La Capella and La Polla near Seravezza. In 1505, during his first trip to procure marble for the tomb project, he worked at Polvaccio,[36] located in the Torano basin (Map 1).[37] In 1516 and early 1517, Michelangelo ordered blocks from the Polvaccio area and from Sponda,[38] also in the Torano field. But, as Vasari explained,

> In the mountains of Carrara … there are many varieties of marble, some black, some verging towards grey, some mingled with red and others again with grey veins. These form an outer crust over the white marbles, and they take those colours, because they are not refined, but rather are smitten by time, water and the soil.[39]

The rocks' stratification complicated the quarrying process; negotiating the red veins (probably a result of iron oxide seeping into the rock) and grey streaks (like in *bardiglio* marble inflected with organic matter) required time.[40] In addition to coloration caused by minerals seeping into stones, marble's "outer crust" – the result of exposure to sun and weather – presented technical challenges when workers roughed out the figures in the blocks.[41] In 1516, Michelangelo wrote from Carrara that he was "quarrying in many places" for the tomb project and expected blocks to be ready in two months.[42] Michelangelo's two-month timeline assumed quarrying would progress smoothly. But, as he wrote, many things could go wrong: excavated blocks revealed "defects" that were not previously apparent; blocks broke as workers moved them from the quarry down the mountainside; and weather intervened, among other problems.[43]

[34] For a summary of the geology and description of major topographical elements, see Giovanni Zanchetta et. al., "The Corchia Cave (Alpi Apuane): a 2 Ma long temporal window on the Earth climate," *Geological Field Trips* 3, no. 2.1 (2011): 11-12; Carlo Baroni, et. al., "Geomorphological map and raised-relief model of the Carrara Marble Basins, Tuscany, Italy," *Geografia Fisica e Dinamica Quaternaria* 33 (2010): 235.
[35] Samples of Carrara marble have born this out in scientific analysis. For instance, note the sample described by Jervis, which was 98% calcium carbonate. W.P. Jervis, *The Mineral Resources of Central Italy: including Geological, Historical, and Commercial Notices of the Mines and Marble Quarries; with a supplement containing an account of the mineral springs* (London: Edward Stanford, 1868), 3.
[36] Michelangelo-Milanesi, *Contratti Artistici*, 631.
[37] For a catalogue of the historical quarry sites near Carrara and Seravezza, see Jervis, *Mineral Resources*. For the history of development of quarries at Carrara, Klapisch-Zuber, *Les maitres du marbre*.
[38] On Polvaccio: Michelangelo-Milanesi, *Ricordi*, 568-570; Michelangelo-Milanesi, *Contratti Artistici*, 631-632, 654, 655, 667. On Sponda: Michelangelo, *Carteggio*, II, 1967, 190-191; Michelangelo-Milanesi, *Ricordi*, 577; Michelangelo-Milanesi, *Contratti Artistici*, 689.
[39] Giorgio Vasari, *Vasari on Technique. Being the Introduction to the Three Arts of Design, Architecture, Sculpture and Painting, Prefixed to the Lives of the Most Excellent Painters, Sculptors and Architects*, trans. Louisa S. Maclehose (London: J.M. Dent & Company, 1907), 45. For description of some of the mineral deposits responsible for the layering of various colors of marble around the white or statuary marble at Carrara and Seravezza, see also Jervis, *Mineral Resources,* 3-8, 10-15. For descriptions of the qualities of the stones at the various Apuan quarry sites, see Emanuele Repetti, *Sopra l'Alpe Apuana ed i Marmi di Carrara* (Fiesole: Badia Fiesolana, 1820).
[40] Jervis, *Mineral Resources,* 4-5.
[41] I am grateful to the sculptor Craigger Browne for sharing insights about the material, tools, and technical concerns of marble carving.
[42] Michelangelo, *Carteggio,* I, 1965, 201.
[43] See, for example, the following letters referring to such problems: Michelangelo, *Carteggio*, I, 1965, 277-279; Michelangelo, *Carteggio*, II, 1967, 82-83; Michelangelo, *Carteggio*, II, 1967, 129-130.



Map 1. Locations of Torano basin, Seravezza basin, and select Apuan quarries. Map created with Google Earth Pro, Catherine Walsh, 2019. Basemap source: OpenStreetMap. Data sources: mindat.org; Google Earth; *Asch, K. (2005): IGME 5000: 1 : 5 Million International Geological Map of Europe and Adjacent Areas - final version for the internet.- BGR, Hannover.*

The ten sculptures under consideration here originated from these veins of marble whose metamorphosis began tens of millions of years ago; quarry workers liberated the blocks from the mountain in a matter of months. The void where the material once existed persistently grows larger. This initial space of the sculptures is unstable; geographical and geological features have changed shape due to the extraction of stone over the course of millennia. Emperors, sculptors, architects, dukes, and modern international corporations are among those who have exploited the Carrara and Seravezza quarries since antiquity.

The specific quarry locations discussed above appealed to early modern artists who repeatedly ordered blocks from them; undoubtedly these orders required quarry workers to overwrite marks of previous excavations as they harvested more stone. Since the nineteenth century, humans have taken tens of millions of tons of rock from these quarries.[44] Modern blasting techniques

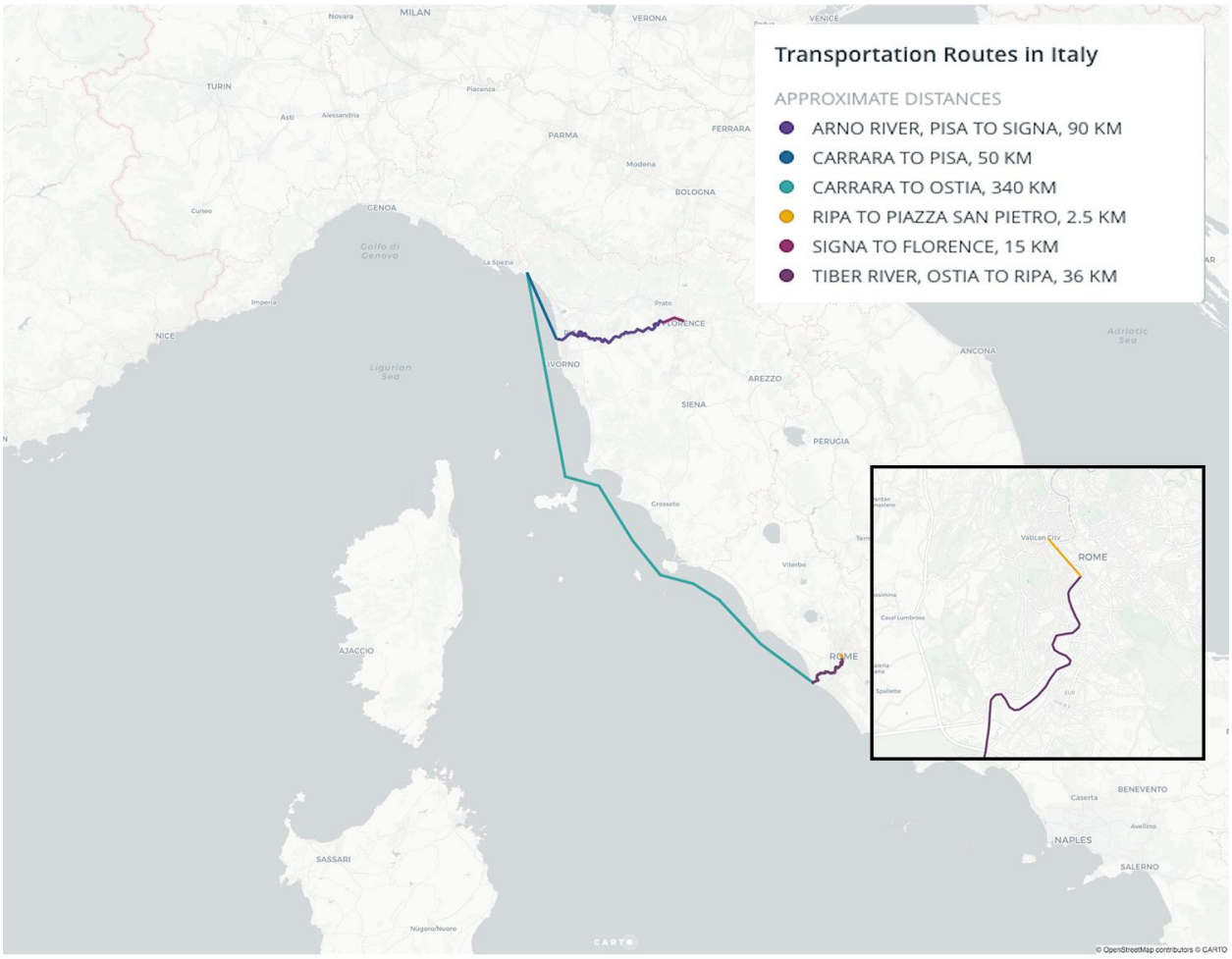
[44] Between 1850-1900, fewer than 100,000 tons per year were extracted from Carrara quarries. In 2009, 3,930,000 tons were extracted, and 70% of this volume became detritus; 30%, or about 1,179,000 tons, of marble extracted from the Carrara quarries, was used. Baroni, et. al., 234. According to industry reports, in 2018, 1,245,005 tons of marble and slabs were exported from Italy. See "Export lapideo: anche il quarto trimestre 2018 si chiude con la flessione delle esportazioni nazionali. Confermato l'aumento delle esportazioni di lavorati verso India e Malesia. Tiene l'export dei lavorati Apuani, mentre calano le esportazioni degli altri distretti," Internazionale Marmi e Maccine Carrara, accessed August 26, 2019, http://newsite.immcarrara.com/export-lapideo-anche-il-quarto-trimestre-2018-si-chiude-con-la-flessione-delle-esportazioni-nazionali-confermato-laumento-delle-esportazioni-di-lavorati-verso-india-e-malesia-tiene-l/

erased evidence of past quarrying activities. Because of these quarrying practices, the sculptures' exact origins are difficult to locate; they cannot be indicated with precision comparable to the workshop spaces, garden grottos, or museum galleries the sculptures inhabited during the five centuries following the blocks' extraction. Knowledge about the duration of marble in the mountainside quarries – during Deep Time and during the months-long transition from raw material to roughed-out blocks – is fuzzy in the geological and archival record, due to both environmental and anthropogenic forces that transformed the spaces of the marble basins. As a result, the digital geographic visualization of the places the tomb sculptures inhabited in Deep Time and during the time of excavation reflects compromise and generalization.

The early modern stone hunter Cyriacus of Ancona (1391-1453?) also thought of stones as archives. According to Cyriacus' biographer Francesco Scalamonti, "It appeared to him … that the stones themselves afforded to modern spectators much more trustworthy information about their [culture's] splendid history than was to be found in books."[45] When the two-month (or longer) excavation period commenced, the stones quarried for the tomb project began to hold this kind of information, in addition to the data of Deep Time. Tool marks from wedging, cleaving, and roughing out the blocks marked the time of human work.[46] At the same time that the sculptures bear witness to these activities and their temporal frames, the marks remind us of the absence of material archives. Moreover, the tool marks signal early modern temporalities that were affected by how the natural environment (irregular topography, rough terrain, precipitation, and flooding) physically shaped the spatial organization of transportation systems and methods.

Many months passed between the excavation periods of 1505-06 and 1516-18 and delivery of the marble to Rome and Florence. For example, in 1505-06, at least nine months passed before the first shipment arrived in Rome at the end of January 1506.[47] In July 1513, Michelangelo was still waiting for an order placed in Carrara in 1506.[48] In March 1517, he expected to wait a year for some orders to arrive in Florence from Carrara.[49] The delays between placing an order, beginning excavation, and delivery of marble were due to negotiations with quarrying firms and the time required to successfully harvest a block of stone, as well as shipping time and shipping delays. The following summary of shipping practices is indebted to the scholarship of Wallace, who estimated the distances and time required for moving marble through distinct segments of the Carrara-Florence itinerary.[50] As Wallace outlined the process, excavated blocks first were lowered down the mountainside to the staging area on the beach nearby; this could take as long as a day, depending upon the size of the block. Then blocks were loaded on ships to travel from Carrara to Pisa, 50 kilometers. The time required for this section of the trip, along the coast, varied greatly due to weather at sea. Once at Pisa, the shipment waited in port until the rainy season (December - April) so that the Arno River would be high enough for the barges to proceed to the port at Signa (about 90 kilometers up river) and so that oxen were available (i.e. not plowing) and could be used for pulling carts from Signa to Florence, 15 kilometers.[51] Moving up the Arno took from one week to three weeks, and oxcarts needed a couple of days to reach the center of Florence. In total, Wallace estimates, the marble blocks traveled about 150 kilometers and for as long as a year (Map 2).[52]

[45] Quoted in Marina Belozerskaya, "Sailing through Time and Space: How Cyriacus of Ancona Rediscovered the Classical Past," in Jaynie Anderson, ed., *Crossing Cultures: Conflict, Migration and Convergence: the proceedings of the 32nd International Congress of the History of Art* (Victoria, Australia: The Miegunyah Press, 2009), 170.
[46] On quarrying practice, tools, and marks see J.B. Ward-Perkins, "Quarries and Stoneworking in the Early Middle Ages: The Heritage of the Ancient World," *Artigianato e tecnica nella società dell'alto medioevo occidentale* 2 (Spoleto, 1971), 525-544.
[47] Michelangelo, *Carteggio*, I, 1965, 11-12.
[48] Michelangelo, *Carteggio*, I, 1965, 144.
[49] Michelangelo, *Carteggio*, I, 1965, 267.
[50] Wallace, *Michelangelo at San Lorenzo*, 38-61.
[51] For a more detailed description of this journey, see Wallace, *Michelangelo at San Lorenzo*, 53-61. For information about coastal shipping routes, the use of rivers, and overland routes see Fernand Braudel, *The Mediterranean and the Mediterranean World in the Age of Phillip II*, Vol. I, trans. Siân Reynolds (New York: Harper & Row, 1966), 103, 278-281.
[52] Wallace, *Michelangelo at San Lorenzo*, 45.



Map 2. Shipping routes and estimated distances between quarries and workshops in Florence and Rome. Map created with CARTO and Google Earth Pro, Catherine Walsh, 2019. Basemap source: OpenStreetMap. Data sources: Google Earth Pro.

From Carrara to Rome, the journey by sea was perhaps seven times longer; the journey up river was about one-third as long (Map 2). From Carrara to Ostia, the seaport of the Tiber River, is roughly 340 kilometers. From Ostia to Ripa, the Tiber port in Rome where Michelangelo's marble shipments were unloaded, is about 36 kilometers. From Ripa, the blocks traveled by oxcart 2.5 kilometers to Piazza San Pietro (where he stored materials and had a workshop nearby). After 1513, blocks stored in Piazza San Pietro could have been moved 2.9 kilometers to his new Macello dei Corvi workshop; newly arrived blocks, 1.6 kilometers from Ripa to Macello dei Corvi. Barges carrying marble traveled up river at a rate of 4.3 – 12 kilometers per day.[53] Thus, traveling from Ostia to Ripa might have taken three to seven days. Moving marble by oxcart from Ripa to either Piazza San Pietro or Macello dei Corvi would have taken a few hours per load. In total, marble blocks traveled approximately 380 kilometers from Carrara to the Roman workshops. As mentioned above, the first marble shipment for the tomb project arrived in Rome in January 1506, nine months after Michelangelo began his first visit to Carrara. Allowing two months for quarrying and a couple of weeks for moving up the Tiber and through the city, we can imagine that most of the time for the journey from Carrara to Rome was spent at sea and/or waiting at port in Avenza or Ostia for

[53] These calculations are based upon Wallace's estimates, and supported by the documents related to marble shipments cited throughout this study.

agreeable weather. The marbles' transit time, thus, was tied to the behavior of water: Mediterranean Sea weather, rain patterns, and river levels. While weather at the quarry affected the raw material, and, in turn, the time of excavation and rough-cutting, maritime weather determined how quickly marble moved from the quarry to the workshop.

Time required for quarrying varied from block to block and order to order, as it did for shipping; and we do not have precise information about these activities for every block.[54] In the absence of precise and complete metadata for each block's journey, the map visualizes the time and distances estimated above and uses the Polvaccio quarry location and the Avenza port location as points of origin and transport for all blocks, even though each block's presence at these places is not fully documented. Likewise, the visualizations of overland routes (Signa to Florence, Ripa to Piazza San Pietro, and Ripa to Macello dei Corvi) are hypothetical.[55]

The roughed out marble blocks quarried and shipped in 1505 arrived in Rome at the port of Ripa on January 31, 1506. Before the marble could be moved to the workshop, the river flooded, and the marble was underwater at Ripa for some time. Vasari reported that in 1506, marble for the tomb had been delivered to Rome, where the blocks "filled half the Piazza di S. Pietro, round about S. Caterina, and between the church and the corridor that goes to the Castello," close to a workshop used for the tomb project.[56] In early May, Michelangelo was waiting on more marble ordered in Carrara for the tomb project and offered to have the blocks delivered to Florence, where he wanted to work on them.[57] However, Pope Julius II was not amenable to this, and by November 1506, Michelangelo agreed to halt work on the tomb and turn his attention to other projects, including the Sistine Chapel ceiling. In 1512, after the ceiling was finished, the pope ordered Michelangelo to resume work on the tomb; in 1513, Michelangelo purchased a house in Macello dei Corvi, in Rome, where he worked on the tomb sculptures off and on for the next three decades.

Between 1513 and 1515, Michelangelo began sculpting the *Dying Slave*, *Rebellious Slave*, and *Moses* in the Macello dei Corvi workshop; these sculptures may have been completed by 1516, though *Moses* was probably reworked, or, possibly, begun later.[58] Between 1513 and 1542, Michelangelo renegotiated the contract for the project four times; as a result, the deadline for completion changed as many times. Between 1516 and 1542, the requirements of other patrons, notably Pope Leo X (r. 1513-1521) and Pope Paul III (r. 1534-1549), distracted Michelangelo from the Tomb of Julius II. Sculpting proceeded intermittently. By 1534, the *Victory* and the four Accademia *Slaves* were in process in Florence.[59]

Tool marks from the time of sculpting added to the material record created by the marks of quarrying; at the same time, sculpting destroyed or obscured some evidence of quarrying. For example, point marks at the bend in *Atlas'* (Fig. 2) left arm form peaks in the stone near his elbow and leave a ridge underneath it. These marks attest to the removal of larger portions of stone, where the artist worked his way in from the planes created during quarrying and rough-cutting phases. In turn, tooth chisel marks, for example on the right leg of the figure, further define its contours and overwrite evidence of the rougher marks of the point chisel that would have been used earlier in the process of carving the leg. These marks are archives of the time of sculpting: they indicate distinct phases in

[54] Between 1516 and 1520, Michelangelo focused on quarrying efforts for the façade of San Lorenzo and ordered marble from both Carrara and Seravezza for this project. The temporal overlap between the tomb project and the San Lorenzo façade project, changing shipping schedules, and the fluid way that roughed out blocks might have been swapped between projects call into question whether or not all blocks for the tomb were sourced from the Carrara quarries, or if some of the Florentine sculptures might be of Seravezza marble.

[55] To estimate and visualize the distances of these routes, the Google Earth Pro measuring tool was used and this data was transferred from Google Earth Pro to CARTO as a .KML file. The coastal route's length is highly uncertain and hypothetical. The distances and routes up river are essentially fixed and certain. To calculate distances from the river ports to the Florentine and Roman workshops, sixteenth-century maps of Florence and Rome were cross-referenced with Google Earth Pro to facilitate the tracing of routes through the city center along roads that existed in the early modern period, when possible.

[56] Vasari, 659.

[57] Michelangelo, *Carteggio*, I, 1965, 13-14.

[58] De Tolnay, *Sculptor, Painter, Architect*, 83; Pope-Hennessy, *Sculpture*, 91; Zöllner, Thoens, and Pöpper, *Michelangelo*, 383, 386-387.

[59] De Tolnay, *Sculptor, Painter, Architect*, 90. Pope-Hennessy, *Sculpture*, 95-100. Pope-Hennessy dates these figures to 1519-1526. Zöllner, Thoens, and Pöpper, *Michelangelo*, 383-384, 388-389.

the sculpting process and index the artist's and stone's presence in the workshop.

By 1542, the Florentine sculptures and the two Roman *Slaves* were eliminated from the tomb's design. Between 1542 and 1545, Michelangelo finished the *Moses* and two more sculptures, *Rachel* and *Leah*. Michelangelo completed the monument in 1545, four decades after beginning it. But the movement of the marble continued.

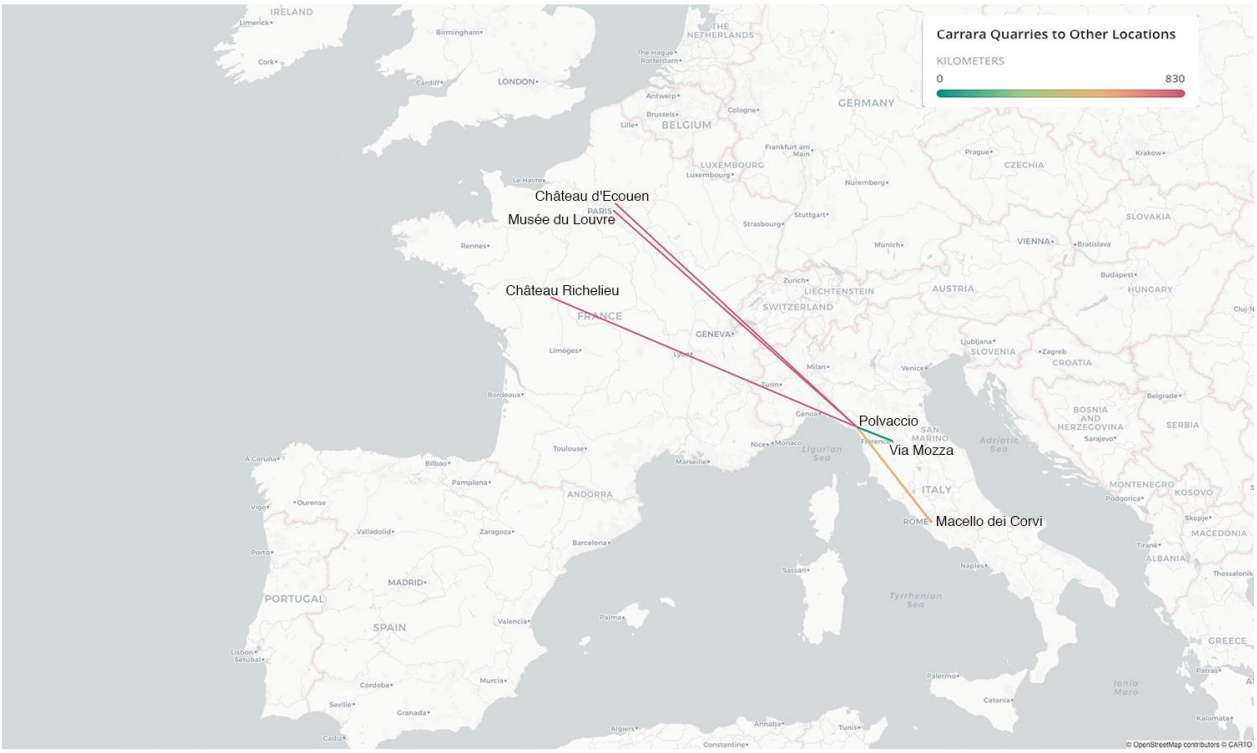
Conclusions: Entombment, Reuse, and Refuse

Collectively, the blocks and sculptures moved at least 37 times and traveled roughly 6,600 kilometers over four centuries. Ultimately, the ten Apuan marble objects we have been tracking landed in Rome, Florence, and Paris. The marble was displaced from its geological origin by as many as 830 kilometers (Map 3).

The tomb, including the three sculptures finished between 1542 and 1545, persists in San Pietro in Vincoli today. At some point after 1544, Michelangelo gave the *Dying Slave* (Fig. 1) and the *Rebellious Slave* to Roberto Strozzi (d. 1566), whose intention was to give them to the French king Francis I (r. 1515-1547).[60] However, Francis I died before the diplomatic gift could be made; instead, his son Henri II received but did not keep the sculptures. Henri gave them to Duke Anne de Montmorency, Constable of France, from whose heirs Cardinal Richelieu (1585-1642) acquired them. In the eighteenth century, they appeared in Paris, still in the Richelieu family. Between 1550 and 1794, these two artworks moved to multiple locations in France including the following: Château d'Ecouen (1550); Château Richelieu (1632); collection of the Marshal of France, Duke of Richelieu, Paris (by 1749); and, finally, the Louvre (1794).[61] In the sixteenth and seventeenth centuries, the *Dying Slave* and *Rebellious Slave* were placed outdoors – in architectural niches, courtyards, and gardens. From the time that Michelangelo left Florence until 1564, the five other unused sculptures remained entombed in his Via Mozza residence. In 1564, Michelangelo's nephew Lionardo Buonarroti (1522-1599) gave them to Cosimo I de' Medici (1519-1574), and in that year the *Victory* was moved to the Palazzo Vecchio.[62] In 1588, garden designer Bernardo Buontalenti (1531-1608) took the four Accademia *Slaves* from Via Mozza and repurposed them in the Grotta Grande of the Boboli Garden. The Accademia *Slaves* remained in the garden grotto for more than four centuries, until they were moved to the museum in 1909 (Maps 4a and 4b).

Mapping the itineraries of these two groups of sculptures – the Louvre *Slaves* and the Accademia *Slaves* – demonstrates that the repurposed sculptures with slightly smaller dimensions, higher polish, and more finely described passages (Louvre *Slaves*) moved more frequently and over longer distances than those with slightly larger, rougher, and blockier forms (Accademia *Slaves*). The locomotion of the former group reflects the political maneuvering of early modern Italian and French collectors; the relative stasis of the latter group is tied in part to their possession by the Medici family for nearly two centuries and by subsequent Grand Dukes of Tuscany until the late nineteenth century. But these patterns of locomotion and stasis also may reveal relationships between location and facture. The *Slaves* possess formal malleability. As representations of human figures, they are multivalent; as individual carved marble sculptures they exhibit a variety of textures and range of polish through which the multiple, coexisting temporal frames of the sculptures appear.[63] This polychronicity is visible in the interplay of passages wherein facture is most apparent with passages wherein facture is nascent with the rough cuts and blocky edges resulting from quarry activity. The variety of textures and

[60] See Ruvoldt, "Michelangelo's Slaves," and Janet Cox-Rearick, *The Collection of Francis I: Royal Treasures* (New York: Harry N. Abrams, Inc., 1996), 294-297.
[61] For the provenance of the Louvre *Slaves*, see de Tolnay, *Michelangelo*, 97-101.
[62] For the provenance of the Louvre *Slaves*, see de Tolnay, *Michelangelo*, 110-118.
[63] In a related vein, Joost Keizer recently argued that the *Slaves* could be understood as purposefully site-unspecific artworks. See Joost Keizer, "Site-Specificity," in *Michelangelo in the New Millennium: Conversations about Artistic Practice, Patronage and Christianity*, ed. Tamara Smithers (Leiden and Boston: Brill, 2016), 25-46.



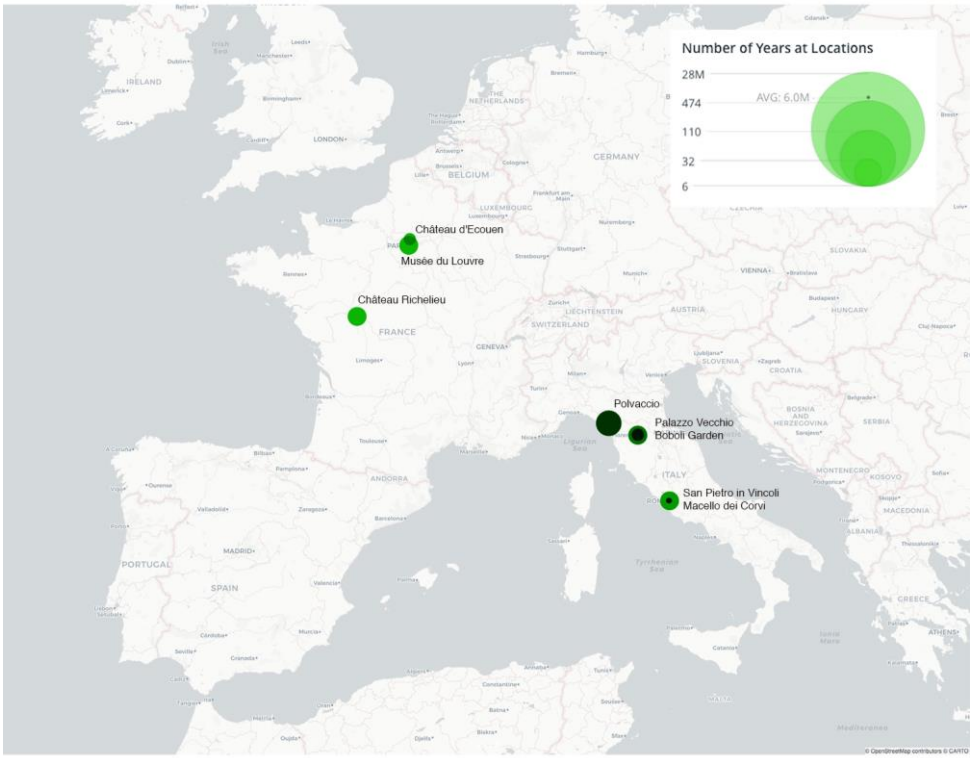
Map 3. Estimated distances between the Polvaccio quarry and select destinations. Map created with CARTO, Catherine Walsh, 2019. Basemap source: OpenStreetMap. Data source: Google Earth.

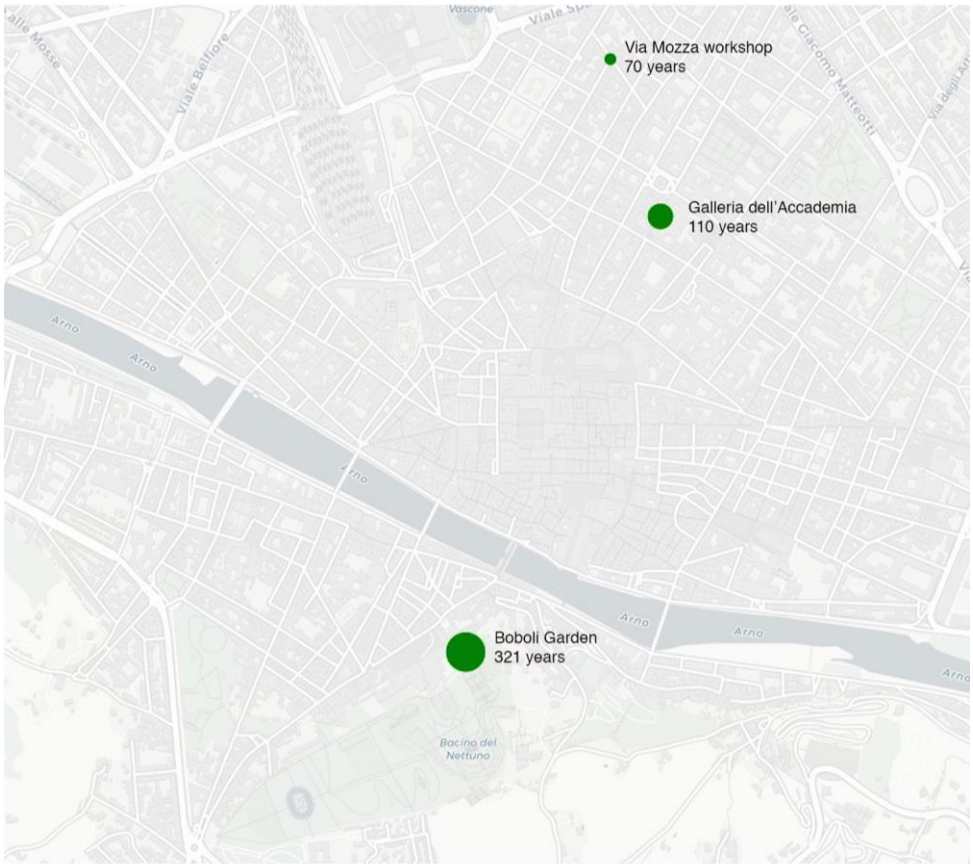
spectrum of polish – reflecting geological time and place and early modern marble carving processes – make these figures mobile, easily repurposed.

The Accademia group lingered for centuries in a semi-outdoor space in which the facture of the sculptures reinforced the facture of the grotto decoration made from geological specimens, shells, and sponges evocative of stony formations.[64] The aspects of the Academia *Slaves*' forms that made them appealing for reuse in the Boboli grotto – their "unfinished" states, the tool marks on their surfaces, and the figures' connections to the blocks from which they are carved – provide scholars insight to marble sculpting processes. For example, Amy Bloch recently suggested the *Atlas Slave* (Fig. 2) is a figuration of marble excavation and the manpower required to move blocks in the sixteenth century.[65] The *Slaves*' shapes, edges, and textures reflect the temporal-spatial relationships brought into focus by the map and explored in the preceding discussion. They make present again geologic Deep Time; the blocks' time of excavation, transport, and sculpting; and the afterlives of the artworks. Their surfaces manifest both the maneuvering of matter through Deep Time and the manipulation of matter by the artist's hand, temporalities that coexist and collide (Fig. 3). The crystalline structure of marble remains visible at close range; long, rough cleave marks and point chisel marks on the outer most "crust" attest to excavation practices, squared corners to roughing out of the block at the quarry; and the many chisel marks describing the contours of the figure and causing the stone to be multi-textured record the artist's work. Through these passages, the sculptures gesture back through geological time and toward the present.

[64] On the use of the Florentine *Slaves* in Bernardo Buonatalenti's Grotta Grande in the Boboli Garden, see for example, Detlef Heikamp, "La Grotta Grande del Giardino di Boboli," *Antichità Viva* 4, no. 4 (1965): 27-43. On the use of these kinds of natural materials in early modern Italian grottoes, see *Arte delle Grotte: per la conoscenza e la conservazione delle grotte artificiali: atti del convegno, Firenze, Palazzo Pitti, Rondò di Bacco, 17 giugno 1985,* ed. Cristina Acidini Luchinat, et.al. (Genoa: Sagep, 1987).

[65] Amy R. Bloch, "Michelangelo's *Atlas Slave* and the Movement of Stone," in *Making and Moving Sculpture in Early Modern Italy,* ed. Kelley Helmstutler Di Dio (Surrey, UK, and Burlington, VT: Ashgate, 2015), 73-74.





Maps 4a and 4b. Accademia *Slaves* and Louvre *Slaves,* number of years at locations, 28,000,000 Ma – 2019, with detail zoomed to Florence center. Markers scaled for duration and overlaid. Map created with CARTO, Catherine Walsh, 2019. Basemap source: OpenStreetMap. Data source: Google Earth.

Figure 3. Michelangelo Buonarroti, *Atlas Slave*, before 1534, marble, 282 cm high (Galleria dell'Accademia, Florence). Detail. Photo credit: Scala / Art Resource, NY.

The sculptures are Oligocenic and Anthropocenic simultaneously. The tomb project not only propelled lithic archives through spaces in early modern and modern Italy and France, but it also catalyzed notable anthropogenic change to the Apuan marble basins. The topography of the Apuan Alps makes the quarry locations extraordinarily rainy and also susceptible to erosion, even without human alteration of the land.[66] Quarrying activity – from antiquity forward – produced enormous amounts of marble detritus filling valley after valley in the quarry areas. This environment generates, among other dangers, landslides due to the accumulation of unused marble. The rocky refuse, built up over two thousand years, is stratigraphic. Geologists read its layers by analyzing tool marks on stone fragments and evaluating the sizes and structures of these fragments.[67] Some of these marble pieces, discarded during the time of quarrying hundreds of years ago, carry bits of data missing from the tomb sculptures. The marble fragments continue to work. They are activated archives, early modern materials comprised of geological matter reflecting Deep Time processes and shouldering modern marble blasting waste.

Looking at these sculptures as archives of environmental art history connects the Deep Time of the materials and the long afterlives of the artworks to the much shorter temporalities of human beings who handled, created, and beheld them and who continue to encounter the sculptures today. Through this lens, the sculptures simultaneously figure the unimaginable dimensions of geological time and how humans have fragmented, transformed, or destroyed the work of Deep Time. The sculptures help us better understand the brevity of human temporal frames compared with those of geology and those of durable stone artworks, and how swiftly and consequentially human acquisition and movement of materials of art changes the earth. Using digital methods to create an interactive map animating the movement of these marble sculptures between places and illustrating their persistence at certain locations facilitates qualitative analysis of temporal and geographical data and allows users of the map to peel back layers of time and space through which the sculptures moved. These methods help us see the sculptures not only as products of patronage, examples of style, and political pawns, but also as mediators of human beings' interactions with the natural environment.

[66] Baroni, et. al., "Carrara Marble Basins," 234-235.
[67] Baroni, et. al., "Carrara Marble Basins," 236-239.